

## B Expectations/ Assessment Criteria

### DP Group 4: Chemistry, DP - Age 16-18, Syllabus - Option A

OPTIONS SL and HL

Option A: Modern analytical chemistry (15/22 hours)

#### A1 Analytical techniques

- A.1.1 State the reasons for using analytical techniques.
- A.1.2 State that the structure of a compound can be determined by using information from a variety of analytical techniques singularly or in combination.

#### A2 Principles of spectroscopy

- A.2.1 Describe the electromagnetic spectrum.
- A.2.2 Distinguish between absorption and emission spectra and how each is produced.
- A.2.3 Describe the atomic and molecular processes in which absorption of energy takes place.

#### A3 Infrared (IR) spectroscopy

- A.3.1 Describe the operating principles of a double-beam IR spectrometer.
- A.3.2 Describe how information from an IR spectrum can be used to identify bonds.
- A.3.3 Explain what occurs at a molecular level during the absorption of IR radiation by molecules.
- A.3.4 Analyse IR spectra of organic compounds.

#### A4 Mass spectrometry

- A.4.1 Determine the molecular mass of a compound from the molecular ion peak.
- A.4.2 Analyse fragmentation patterns in a mass spectrum to find the structure of a compound.

#### A5 Nuclear magnetic resonance (NMR) spectroscopy

- A.5.1 Deduce the structure of a compound given information from its  $^1\text{H}$  NMR spectrum.
- A.5.2 Outline how NMR is used in body scanners.

#### A6 Atomic absorption (AA) spectroscopy

- A.6.1 State the uses of AA spectroscopy.
- A.6.2 Describe the principles of atomic absorption.
- A.6.3 Describe the use of each of the following components of the AA spectrophotometer: fuel, atomizer, monochromatic light source, monochromatic detector and read-out.
- A.6.4 Determine the concentration of a solution from a calibration curve.

#### A7 Chromatography

- A.7.1 State the reasons for using chromatography.
- A.7.2 Explain that all chromatographic techniques involve adsorption on a stationary phase and partition between a stationary

<p>phase and a mobile phase.</p> <ul style="list-style-type: none"> <li>A.7.3 Outline the use of paper chromatography, thin-layer chromatography (TLC) and column chromatography.</li> </ul> <p>A8 Visible and ultraviolet (UV-Vis) spectroscopy (HL)</p> <ul style="list-style-type: none"> <li>A.8.1 Describe the effect of different ligands on the splitting of the d orbitals in transition metal complexes.</li> <li>A.8.2 Describe the factors that affect the colour of transition metal complexes.</li> <li>A.8.3 State that organic molecules containing a double bond absorb UV radiation.</li> <li>A.8.4 Describe the effect of the conjugation of double bonds in organic molecules on the wavelength of the absorbed light.</li> <li>A.8.5 Predict whether or not a particular molecule will absorb UV or visible radiation.</li> <li>A.8.6 Determine the concentration of a solution from a calibration curve using the Beer–Lambert law.</li> </ul> <p>A9 Nuclear magnetic resonance (NMR) spectroscopy (HL)</p> <ul style="list-style-type: none"> <li>A.9.1 Explain the use of tetramethylsilane (TMS) as the reference standard.</li> <li>A.9.2 Analyse <math>^1\text{H}</math> NMR spectra.</li> </ul> <p>A10 Chromatography (HL)</p> <ul style="list-style-type: none"> <li>A.10.1 Describe the techniques of gas–liquid chromatography (GLC) and high-performance liquid chromatography (HPLC).</li> <li>A.10.2 Deduce which chromatographic technique is most appropriate for separating the components in a particular mixture.</li> </ul>	
<b>Approach</b>	<b>Significant concept(s) / Considerations</b>
<p><b>Option-A: Analytical Chemistry</b></p> <p>. interactive classroom based, lecture based teaching</p>	<p>Determination of the exact structure of a particular compound is necessary for various drug design and vaccine invention.</p>
<b>Guiding Questions</b>	<b>Learner Profile</b>
<p>How to determine the structure of a given compound found in nature for industrial synthesis of it or chemical property analysis by the researchers.</p>	<ul style="list-style-type: none"> <li>Inquirers</li> <li>Thinkers</li> <li>Open-minded</li> <li>Risk-takers</li> <li>Reflective</li> </ul>
<b>Central Idea / Content</b>	<b>Learning Objectives</b>
<ul style="list-style-type: none"> <li>A1 Analytical techniques</li> <li>A2 Principles of spectroscopy</li> <li>A3 Infrared (IR) spectroscopy</li> </ul>	<p>Analysis of chemical compounds is essential in terms of new drug design and testing of the old drugs and its effect on human health. But the modern processes has changed the we used to analyze or</p>

<ul style="list-style-type: none"> <li>· A4 Mass spectrometry</li> <li>· A5 Nuclear magnetic resonance (NMR) spectroscopy</li> <li>· A6 Atomic absorption (AA) spectroscopy</li> <li>· A7 Chromatography</li> </ul>	<p>determine the structure of the compound previously. Basically during this course we will be concentrating on NMR, UV-visible and Mass spectra, all or any three and try to analyze them to determine the structure</p>
<p><b>Advanced topics</b></p> <ul style="list-style-type: none"> <li>· A8 Visible and ultraviolet (UV-Vis) spectroscopy</li> <li>· A9 Nuclear magnetic resonance (NMR) spectroscopy</li> <li>· A10 Chromatography</li> </ul>	<ol style="list-style-type: none"> <li>1. State the reasons for using analytical techniques. State that the structure of a compound can be determined by using information from a variety of analytical techniques singularly or in combination. Describe the electromagnetic spectrum. Distinguish between absorption and emission spectra and how each is produced. Describe the atomic and molecular processes in which absorption of energy takes place.</li> <li>2. Describe the operating principles of a double-beam IR spectrometer. Describe how information from an IR spectrum can be used to identify bonds. Explain what occurs at a molecular level during the absorption of IR radiation by molecules. Analyse IR spectra of organic compounds.</li> <li>3. Determine the molecular mass of a compound from the molecular ion peak. Analyse fragmentation patterns in a mass spectrum to find the structure of a compound.</li> <li>4. Deduce the structure of a compound given information from its <math>^1\text{H}</math> NMR spectrum. Outline how NMR is used in body scanners. Explain the use of tetra methyl silane (TMS) as the reference standard. Analyse <math>^1\text{H}</math> NMR spectra.</li> <li>5. State the uses of AA spectroscopy. Describe the principles of atomic absorption. Describe the use of each of the following components of the AA spectrophotometer: fuel, atomizer, monochromatic light source, monochromatic detector and readout. Determine the concentration of a solution from a calibration curve.</li> <li>6. State the reasons for using chromatography. Explain that all chromatographic techniques involve adsorption on a stationary phase and partition between a stationary phase and a mobile phase. Outline the use of paper chromatography, thin-layer chromatography (TLC) and column chromatography. Describe the</li> </ol>

		<p>techniques of gas–liquid chromatography (GLC) and high performance liquid chromatography (HPLC). Deduce which chromatographic technique is most appropriate for separating the components in a particular mixture.</p> <p>7. Describe the effect of different ligands on the splitting of the d orbitals in transition metal complexes. Describe the factors that affect the colour of transition metal complexes. State that organic molecules containing a double bond absorb UV radiation. Describe the effect of the conjugation of double bonds in organic molecules on the wavelength of the absorbed light. Predict whether or not a particular molecule will absorb UV or visible radiation. Determine the concentration of a solution from a calibration curve using the Beer–Lambert law.</p>
<b><u>Assessment</u></b>		
<b>Information Literacy &amp; ICT</b>	<b>International Mindedness</b>	<b>TOK</b>
As analytical chemistry is mostly data dependent, simulations available online on mass and NMR generation will be used for showing and predicting structure	Is the present international patent law is supportive towards the low cost medicine and better human health?	The electromagnetic spectrum is a carrier of information. The nature of the information is limited by its wavelength.
<b>Strategies / Activities / Differentiation</b>		<b>Resources</b>
<p>Strategies:</p> <p>Students will be provided with the information and basic analytical technique using NMR, mass and UV-IR spectra.</p> <p>We will take a few known cases to understand information Given by these techniques and then try to analyze unknown information to determine the structure.</p>		<ul style="list-style-type: none"> <li>· IB chemistry-Geoff Neuss</li> <li>· Chemistry text book-Catrin Brown</li> <li>· IB revision guide-Geoff Neuss</li> <li>· PowerPoint presentations as teaching aid (on core and advanced concepts)</li> <li>· Web resources (teacher tube etc)</li> <li>· IB-Question bank on Acid base equilibrium</li> </ul>

<p>Activities:</p> <p>Activities includes Java applet for NMR spectra interactive</p> <p>Students with ESL background will be provided with a vocabulary and definition list to understand the key terms clearly.</p> <p>differentiation:</p> <p>"Weaker students will be helped individually"</p> <p>a simpler version of worksheet and simple version of instruction is given to the students with difficulties.</p>	<ul style="list-style-type: none"> <li>· Worksheet on             <ul style="list-style-type: none"> <li>o mass spectra</li> <li>o UV and visible spectra</li> <li>o NMR spectra</li> <li>o Chromatography</li> </ul> </li> </ul>
<p><b>Unit Reflections</b></p>	